National Advisory Committee for Aeronautics

Research Abstracts

NO. 54 DECEMBER 14, 1953

CURRENT NACA REPORTS

NACA Rept. 1117

A STUDY OF ELASTIC AND PLASTIC STRESS CONCENTRATION FACTORS DUE TO NOTCHES AND FILLETS IN FLAT PLATES. Herbert F. Hardrath and Lachlan Ohman. 1953. ii, 10p. diagrs., tab. (NACA Rept. 1117. Formerly TN 2566)

Six large 24S-T3 aluminum-alloy-sheet specimens containing various notches or fillets were tested in tension to determine their stress concentration factors in the elastic and plastic ranges. The elastic stress concentration factors were found to be slightly higher than those predicted by other methods. A generalization of a relation presented by Stowell gave good agreement with the plastic stress concentration factors as they decreased with increasing plastic strain.

NACA TN 3029

A FUNDAMENTAL INVESTIGATION OF FRETTING CORROSION. H. H. Uhlig, I. Ming Feng, W. D. Tierney, and A. McClellan, Massachusetts Institute of Technology. December 1953. 52p. diagrs., photos., 2 tabs. (NACA TN 3029)

This report summarizes all phases of an investigation of fretting corrosion which has been conducted over a period of several years. The presentation of the information is made in three parts. Part I describes a test machine for measuring fretting damage under controlled experimental conditions. Part II presents data for mild steel fretted against itself. Consideration is given to the effects of humidity, temperature, test duration, atmosphere, relative slip, pressure, and frequency. Part III suggests a mechanism for the fretting process.

NACA TN 3047

IMPINGEMENT OF WATER DROPLETS ON NACA 65A004 AIRFOIL AND EFFECT OF CHANGE IN AIRFOIL THICKNESS FROM 12 TO 4 PERCENT AT 4° ANGLE OF ATTACK. Rinaldo J. Brun, Helen M. Gallagher and Dorothea E. Vogt. November 1953. 45p. diagrs., tab. (NACA TN 3047)

The trajectories of droplets in the air flowing past an NACA 65A004 airfoil at an angle of attack of 4° were determined. The amount of water in droplet form impinging on the airfoil, the area of droplet impingement, and the rate of droplet impingement per unit area on the airfoil surface were calculated from the trajectories and presented to cover a large range of flight and atmospheric conditions. The effect of a change in airfoil thickness from 12 to 4 percent at 4° angle of attack is presented by comparing the impingement calculations for the NACA 65A004 airfoil with those for the NACA 65_1-208 and 65_1-212 airfoils. The rearward limit of impingement on the upper surface decreases as the airfoil thickness decreases. The rearward limit of impingement on the lower surface increases with a decrease in airfoil thickness. The total water intercepted decreases as the airfoil thickness is decreased.

NACA TN 3049

AN ANALYTICAL INVESTIGATION OF THE EFFECT OF THE RATE OF INCREASE OF TURBULENT KINETIC ENERGY IN THE STREAM DIRECTION ON THE DEVELOPMENT OF TURBULENT BOUNDARY LAYERS IN ADVERSE PRESSURE GRADIENTS. Bernard Rashis. November 1953. 30p. diagrs., 2 tabs. (NACA TN 3049)

A general integral form of the boundary-layer equation which includes the Reynolds normal-stress term is derived. Two special equations are obtained from the general form. They are the modified momentum equation and the modified kinetic-energy equation. In addition, the parameters which control the dissipation of mean-flow kinetic energy by the shearing stress and the Reynolds normal stress are suggested.

NACA TN 3056

A FLIGHT INVESTIGATION OF LAMINAR AND TURBULENT BOUNDARY LAYERS PASSING THROUGH SHOCK WAVES AT FULL-SCALE REYNOLDS NUMBERS. Eziaslav N. Harrin. December 1953. 20p. diagrs., photos. (NACA TN 3056)

An investigation was made in flight at free-stream Mach numbers up to about 0.76 and Reynolds numbers up to about 26×10^6 to determine the behavior of laminar and turbulent boundary layers passing through shock waves. Boundary-layer and pressure-distribution measurements were made on a short-span airfoil built around a wing of a fighter airplane. The free-stream Mach numbers reached in the tests were sufficiently high to give extensive regions of local supersonic flow. Comparison is made with results of tests at low Reynolds numbers (up to 1/10-scale) of other investigations.

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BRITISH REPORTS

N-27007*

Royal Aircraft Establishment (Gt. Brit.)
THE CALCULATION OF THE PRESSURE DISTRIBUTION OVER THE SURFACE OF TWO-DIMENSIONAL AND SWEPT WINGS WITH SYMMETRICAL AEROFOIL SECTIONS. J. Weber. July 1953. 84p. diagrs., 13 tabs. (RAE Aero 2497. Rewritten and amended version of RAE Aero 2391)

A simple method is described for calculating the pressure distribution on the surface of a thick two-dimensional airfoil section, at any incidence, in incompressible potential flow. It is particularly suitable for practical applications, since knowledge of the section ordinates only is required. This paper gives a complete derivation of the theory including a detailed discussion of the approximations made and their effect on the accuracy of the results. The pressure distributions calculated by the present method are identical with the exact values for airfoils of elliptic cross section, and the numerical values for Joukowsky airfoils agree well with the exact solutions.

N-27056*

Royal Aircraft Establishment (Gt. Brit.)
DESIGN AND CALIBRATION AT LOW SPEEDS OF A STATIC TUBE AND A PITOT-STATIC TUBE WITH SEMI-ELLIPSOIDAL NOSE SHAPES. D. J. Kettle. May 1953. 31p. diagrs., 5 tabs. (RAE Tech. Note Aero 2247)

A new static tube and a new pitot-static tube have been designed and calibrated in the No. 1 and the No. 2 11-1/2 foot by 8-1/2 foot wind tunnels of the R. A. E., using a long static tube, the error of which is believed to be very small, as a standard for comparison. The results show that the static pressure measured by these tubes is in error due to the supporting strut and to the nose shape of the tube by an amount which may be calculated for positions of the static slot, or holes, greater than 10 tube diameters ahead of the strut. The readings show no measurable scale effect in the speed range 100-230 ft/sec. The static tube is insensitive to yaw in the range $\pm 1^{\circ}$ with a square-edged slot and is even less sensitive to yaw when the slot edges are rounded. The turbulence of the tunnel has an effect on the static-pressure reading.

N-27057*

Royal Aircraft Establishment (Gt. Brit.)
COMPRESSIBILITY EFFECT ON GUST LOADS. J. K. Zbrozek. August 1953. 20p. diagrs. (RAE Tech. Note Aero 2254)

Theoretical calculations of the gust alleviation factor for a range of Mach numbers show an appreciable decrease in its value with increasing Mach number. The reduction in the value of the gust factor at $M = 0.7$ is about 10 percent for sharp-edged gusts and lightly loaded aircraft ($\mu_g = 20$) and decreases to about 5 percent for gust length of 10 chords and heavy aircraft ($\mu_g = 100$). The analysis of existing flight records indicates that the gust loads at high Mach numbers can be estimated satisfactorily if the gust factor and the lift slope are corrected for compressibility.

N-27058*

Royal Aircraft Establishment (Gt. Brit.)
WIDE RANGE AMPLIFIER FOR TURBULENCE MEASUREMENTS WITH ADJUSTABLE UPPER FREQUENCY LIMIT. H. Schuh and D. Walker. August 1953. 42p. diagrs. (RAE Aero 2492)

The amplifier described in this report was originally planned for turbulence work at supersonic speeds; it was soon apparent that with some modifications, the same equipment could be used also at subsonic speeds. In its final version, it is suitable for measuring subsonic wind-tunnel turbulence of low intensity.

N-27059*

Royal Aircraft Establishment (Gt. Brit.)
THE TIME VECTOR METHOD FOR STABILITY INVESTIGATIONS. K. H. Doetsch. August 1953. 50p. diagrs., tab. (RAE Aero 2495)

A semigraphical method for the analysis of aircraft stability oscillations is described. It is based on the concept of rotating time vectors representing the forces and moments acting on the aircraft. Rules are developed for the application to damped and divergent oscillations. The method is iterative, simple and rapid. Close correlation with the physical facts of the motion is maintained and the contribution of each force and moment can be visualized. The immediate deduction of approximate formulas and their limitations is demonstrated and the application of the method to automatic control is discussed.

N-27126*

Aeronautical Research Council (Gt. Brit.)
THE FLOW AT THE MOUTH OF A STANTON PITOT. A. Thom. October 2, 1952. 9p. diagrs. (ARC 15, 228; FM 1796; Oxford Univ., Engineering Lab. No. 61)

An arithmetical calculation is made of the flow at the mouth of a Stanton pitot as the Reynolds number tends to zero. A stationary eddy is found under the lip of the pitot. A figure is found for the height of the effective center of the pitot rather greater than the experimental value determined by Sir Geoffrey Taylor.

N-27127*

Aeronautical Research Council (Gt. Brit.)
INTEGRATION OF THE EQUATIONS OF TRANSONIC FLOW IN TWO DIMENSIONS. D. Meksyn. November 25, 1952. 23p. 2 tabs. (ARC 15,412; FM 1819)

The problem of integration of the equations of compressible flow past a solid body has been considered in numerous papers. The solutions have been quite laborious. In this paper, a method is given in which the integration leads to an algebraic equation of the fifth degree which can be evaluated at any given point. The critical point of this equation determines the critical Mach number when a shock wave first appears. The method is applied to the motion past a circular cylinder and to the flow past an airfoil of thickness 1/10 consisting of two arcs with cusps at the leading and trailing edges. The results agree with Kaplan's calculations.

N-27128*

Aeronautical Research Council (Gt. Brit.)
THE ARITHMETIC OF FIELD EQUATIONS.
A. Thom. November 26, 1952. 29p. diagrs.
(ARC 15,419; FM 1821; Oxford Univ., Engineering Lab. No. 63)

The paper describes in detail an older and more rapid method than relaxation of approximating to the solution of equations of the Laplace and Poisson type. The corresponding fourth order equations are also discussed. A description is given of the propagation of errors in the fields due to various causes.

N-27129*

Aeronautical Research Council (Gt. Brit.)
ON THE ENERGY SCATTERED FROM THE INTERACTION OF TURBULENCE WITH SOUND OR SHOCK WAVES. M. J. Lighthill. December 1, 1952. 24p. diagrs., tab. (ARC 15,432; FM 1825)

The energy scattered when a sound wave passes through turbulent fluid flow is studied by means of the author's general theory of sound generated aerodynamically. Energy freely scattered when turbulence is convected through the stationary shock wave pattern in a supersonic jet may form an important part of the sound field of the jet.

MISCELLANEOUS

NACA TN 2893

Errata No. 1 on "THEORETICAL AND MEASURED ATTENUATION OF MUFFLERS AT ROOM TEMPERATURE WITHOUT FLOW, WITH COMMENTS ON ENGINE-EXHAUST MUFFLER DESIGN."
Don D. Davis, Jr., George L. Stevens, Jr., Dewey Moore and George M. Stokes. February 1953.

DECLASSIFIED NACA REPORTS

THE FOLLOWING REPORT HAS BEEN DECLASSIFIED FROM SECRET TO UNCLASSIFIED, 11/10/53.

NACA RM L52E22

NOTES ON THE GUST PROBLEM FOR HIGH-SPEED LOW-ALTITUDE BOMBERS. Langley Gust Loads Branch. June 5, 1952. 23p. diagrs., 3 tabs. (NACA RM L52E22)

Available information pertaining to the gust problem for the high-speed low-altitude bomber has been collected and coordinated. Gust data of interest in this special problem have been presented and the general information for design has been indicated.

THE FOLLOWING REPORTS HAVE BEEN DECLASSIFIED FROM CONFIDENTIAL TO UNCLASSIFIED, 11/10/53.

NACA RM L6J14

DRAG MEASUREMENTS OF SYMMETRICAL CIRCULAR-ARC AND NACA 65-009 RECTANGULAR AIRFOILS HAVING AN ASPECT RATIO OF 2.7 AS DETERMINED BY FLIGHT TESTS AT SUPERSONIC SPEEDS. Sidney R. Alexander. March 7, 1947. 10p. diagrs., photo. (NACA RM L6J14)

Flight tests have been conducted at supersonic speeds to determine the drag characteristics at zero lift of a wing having a circular-arc airfoil section with a maximum thickness of 9 percent chord. The wing plan form was rectangular and had an aspect ratio of 2.7. Included for comparison are results of similar tests previously conducted on an NACA 65-009 airfoil. For the Mach number range investigated (0.85 to 1.22), the NACA 65-009 airfoil produced lower values of drag coefficient than the circular-arc airfoil.

NACA RM L6J23

RESULTS OF PRELIMINARY FLIGHT INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF THE NACA TWO-STAGE SUPERSONIC RESEARCH MODEL RM-1 STABILIZED IN ROLL AT TRANSONIC AND SUPERSONIC VELOCITIES. Marvin Pitkin, William N. Gardner and Howard J. Curfman, Jr. March 19, 1947. 55p. diagrs., photos. (NACA RM L6J23)

The design of a two-stage, solid-fuel, rocket propelled, general research pilotless aircraft (RM-1) suitable for investigating stability and control at supersonic velocities is discussed. The flight-test investigation conducted thus far is discussed and information is presented on zero-length launchers and operational flight-test techniques of two-stage rockets.

NACA RM L6K08c

DRAG MEASUREMENTS AT TRANSONIC SPEEDS OF NACA 65-009 AIRFOILS MOUNTED ON A FREELY FALLING BODY TO DETERMINE THE EFFECTS OF SWEEPBACK AND ASPECT RATIO. Charles W. Mathews and Jim Rogers Thompson. January 22, 1947. 14p. diagrs., photos. (NACA RM L6K08c)

Drag measurements at transonic speeds on rectangular airfoils and on airfoils swept back 45° are reported. These airfoils, which were mounted on cylindrical test bodies, are part of a series being tested in free drops from high altitude to determine the effect of variation of basic airfoil parameters on airfoil drag characteristics at transonic speeds. These rectangular and sweptback airfoils had the same span, airfoil section (NACA 65-009), and chord perpendicular to the leading edge. The tests were made to compare the drag of rectangular and sweptback airfoils at a higher aspect ratio than had been used in a similar comparison reported previously.

NACA RM L52E05

PRELIMINARY EXPERIMENTS ON THE ELASTIC COMPRESSIVE BUCKLING OF PLATES WITH INTEGRAL WAFFLE-LIKE STIFFENING. Norris F. Dow and William A. Hickman. July 1952. 13p. diagrs., photo., tab. (NACA RM L52E05)

An experimental investigation was made of the elastic compressive buckling strength of plates having various configurations of integral stiffening. Configurations tested included ribbing that was longitudinal, transverse, longitudinal and transverse, and skewed at various angles to the sides of the plates to form a diamond or waffle-like pattern. The 45° waffle stiffening was found to be the most effective of all those considered, giving a buckling load nearly double that for the same waffle pattern with the ribbing longitudinal and transverse.

NACA RM L53E13a

FORMULAS FOR THE ELASTIC CONSTANTS OF PLATES WITH INTEGRAL WAFFLE-LIKE STIFFENING. Norris F. Dow, Charles Libove and Ralph E. Hubka. Ausust 1953. 67p. diagrs., tab. (NACA RM L53E13a)

Formulas are derived for the elastic constants of plates with integral ribbing. The constants, which include the effectiveness of the ribs for resisting deformations other than bending and stretching in their longitudinal directions, are defined in terms of four coefficients, and methods for the evaluation of these coefficients are discussed. Four of the more important elastic constants are predicted by these formulas and are compared with test results.